Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Unlicensed Use of the 6 GHz Band	)	ET Docket No. 18-295

February 13, 2019

Comments of
THE FRIDAY INSTITUTE FOR EDUCATIONAL INNOVATION AT NORTH CAROLINA STATE UNIVERSITY

Background

The Friday Institute for Education Innovation, part of the College of Education at North Carolina State University, provides strategic thought leadership on issues related to student connectivity for the entire state of North Carolina. Over the last decade, the Friday Institute, in cooperation with the North Carolina Department of Public Instruction (NCDPI), has developed a program that ensures that virtually every public school in North Carolina has a fiber connection and that virtually every classroom has a Wi-Fi access point. North Carolina has accomplished this with the support of the FCC E-rate program and the concerted efforts of numerous educators in the state.

In the four years since the E-rate modernization order in 2014, North Carolina public schools have received over $115,000,000 in E-rate discounts for Category Two (internal connections) with another $25,000,000 of Category Two E-rate discounts expected to be disbursed this year. The vast majority of that funding has been used to provide Wi-Fi access points and the associated switching infrastructure. Data from the NCDPI shows that the state's 2,600 public schools collectively have over 125,000 Wi-Fi access points deployed, all of which use unlicensed spectrum. Almost all of these access points have been procured with Universal

Service Fund (USF) E-rate funding. We believe that opening the 6 GHz band to unlicensed use, with an easy-to-understand spectrum management system, will spur innovation, increase network capacity for students, and reduce capital and operational costs of school networks. We support the numerous comments and presentations submitted by Apple, Broadcom, et. al., the Wi-Fi Alliance, Ubiquiti Networks and others voicing an interest in spurring innovation in the 6 GHz band. While the focus of these comments is generally directed at the unlicensed use for Wi-Fi, we fully expect other new innovative technologies that we cannot even imagine today will also utilize this spectrum in the classroom.

Challenges in Educational Wi-Fi Networks

As educational content becomes richer, with the advent of virtual reality and augmented reality learning applications, the need for more spectrum is painfully obvious. Today, a typical school with a one-device-per-student pedagogy in North Carolina consists of a classroom with about 25 students, each with a device such as a tablet or Chromebook. Depending on the local school policy, other student-owned Wi-Fi devices such as smartphones and watches may also be granted access to the school's CIPA-compliant (*Children's Internet Protection Act*) network.

Each classroom typically contains an IEEE 802.11ac (Wi-Fi 5) access point, connected to a gigabit Ethernet switch port. Virtually every school in North Carolina is connected to the Internet via fiber, with the majority of the connections being between 1 Gbps and 10 Gbps. Schools are most often constructed with masonry interior (and exterior) walls, although some more modern schools are now being built more openly and with more permeable interior wall materials.

A common deployment strategy to prevent co-channel interference is to disable the 2.4 GHz band Wi-Fi in about two-thirds of the classroom access points. The access points are then configured to use lower power on the 5 GHz channels to minimize the signal that egresses each classroom. Some RF experts have noted that placing an access point in every classroom might be problematic, actually increasing co-channel interference; however, we have found that client density is often the limiting factor in a successful Wi-Fi enabled classroom. Often the only way to support the required client density is to install one AP in each classroom.

Another factor impacting co-channel interference is channel width. Many schools have been found to use 20 MHz channels, even in the 5 GHz band, in order to maximize the number of non-overlapping channels. This effectively limits the data rate provided to each student, possibly preventing individualized learning which often utilizes video-rich lectures and content.

In North Carolina K-12 public schools, we estimate there are more than one million school-owned Wi-Fi devices in use on a daily basis. The number of student-owned and teacher-owned devices could in fact be greater and growing quickly each year. We expect the massive increase in demand for Internet bandwidth in K-12 schools[1] will continue for several more years, as will the number of Wi-Fi connected devices. This in turn means more spectrum will be needed in the classroom. Many of the student devices available today do not have Ethernet interfaces available; wireless connectivity is the only option.

In higher education, classrooms are often much larger, with many more students. Content is also not typically filtered in higher education, so bandwidth demands can be greater. Additionally, the likelihood of video-based lectures being delivered in higher education is increased as compared to K-12. Dormitories also present a unique challenge in higher education, with large numbers of clients accessing Wi-Fi in relatively small physical spaces.

One concrete example of how increased spectrum can reduce (or delay) capital costs occurred recently at a university. The university was considering upgrading the Wi-Fi access points because they were believed to have too little capacity to support future demand. Upon investigation, it was discovered that 20 MHz channels were being used in the 5 GHz band, and that no DFS channels were being utilized, despite the university being many miles from any radar systems. By enabling DFS channels and increasing the channel width to 40 MHz, the access points were effectively able to provide twice the throughput as their previous configuration, extending the useful life of the infrastructure, with no additional cost and no new co-channel interference. For a university with thousands of access points installed, delaying the refresh by just a year could have enormous impact on the capital budget.

[1] See http://go.ncsu.edu/scireport for an interactive dashboard of historic data related to aggregate Internet bandwidth in North Carolina public schools. The vast majority of NC K-12 public schools are connected to a state backbone for aggregated Internet access and CIPA filtering.

Network systems which are overly complex to configure will be met with resistance or simply not used. The details and complexities of the Automatic Frequency Coordination (AFC) functionality need to be transparent to network administrator in schools. We urge the commission to address the concerns of incumbents with a flexible AFC, that allows non-certified staff to deploy equipment that is compliant with all rules. Installation and configuration costs is often a significant factor in educational network deployments. Many schools are able to save significant amounts of money by using their own staff for network build out. Requiring certified or licensed professionals could quickly escalate costs. Ensuring the products are easy to use in compliance with all rules will be a key factor in the success of unlicensed 6 GHz products.

Another challenge in masonry-walled schools is cellular coverage for inner classrooms, those least likely to receive LTE signal from a service provider tower. While technologies like combination Wi-Fi/CBRS access points and LTE over Wi-Fi are available, we expect the unlicensed 6 GHz band to be a key enabler of improved calling capabilities inside schools. This is increasingly important from a safety perspective, as many schools are now looking to implement "panic buttons" and other emergency communications systems. Highly reliable Wi-Fi, Voice over Wi-Fi and private LTE should be the goal of all schools. As voice funding is no longer available in the E-rate program, it is imperative that schools ensure all teachers and staff have access to 911 services from their mobile phones, at all locations inside the school.

The new Wi-Fi standard, IEEE 802.11ax (Wi-Fi 6), will allow for 160 MHz channels with OFDMA scheduling. Adding the 6 GHz band would create seven, non-overlapping channels, which would be a game changer for network performance in densely packed classrooms. We suggest the Commission consider a uniform regulatory framework for the indoor, low-power unlicensed devices in the 6 GHz band. We are concerned that proposed additional frequency coordination requirements on indoor, low-power devices in some portions of the 6 GHz band[2] would fragment accessibility of this spectrum, increase equipment costs and potentially negate many benefits of the Commission's stated objective[3]. As explained in the comments of Wi-Fi Alliance, coordination of indoor, low-power unlicensed transmissions is

[2] In the Matter of Unlicensed Use of the 6 GHz Band, ET Docket No. 18-295, FCC 18-147 (rel. Oct. 24, 2018) (*NPRM*) at ¶23.

[3] NPRM at ¶1.

unnecessary because these transmissions will be attenuated by building entry losses, clutter loss, and polarization mismatch losses, all of which will reduce the signal power to below the harmful interference threshold.[4]

Protecting Incumbents

A cursory search of the FCC ULS shows that there are over 1,000 licenses in the 6 GHz band in the state of North Carolina. Many of these licenses are used for public safety (including a statewide highway patrol voice network), public television backhaul, utility grid operations, and other governmental use.

Numerous unlicensed industry proponents have performed significant research to demonstrate how indoor, low-power use is unlikely to affect these services[5]. Still, we favor rules that err on the side of caution. We suggest the FCC clearly articulate the enforcement policies and penalties that could be assessed on consumers using unlicensed 6 GHz devices outdoors, or contrary to other rules dealing with this band.

Finally, we ask for clear definitions of terms such as "indoor". For example, is a parked RV, mobile home or portable classroom considered an indoor environment? How will the rules prevent the creation of ad-hoc networks in the 6 GHz band where no connection to the Internet (and thus a spectrum allocation system) is even attempted? While we believe that all of the Wi-Fi vendors are acting in good faith and have studied this carefully, we take pause to consider how malicious or ill-informed customers may incorrectly use these products to the detriment of incumbents.

We find it interesting that one of the leading manufacturers of outdoor licensed equipment has submitted comments[6] to the commission requesting less stringent operation in the band, including outdoor operation up to 1W radiated. We cannot provide insight into the technical merit of these comments, but take note of them because they were written by a manufacturer with a substantial portfolio of outdoor licensed and unlicensed point-to-point and point-to-multiport products.

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[4] See letter of Alex Roytblat, Senior Director of Regulatory Affairs, Wi-Fi Alliance, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183 (filed Sept. 18, 2018).

[5] See Apple, Broadcom, et al. Jan. 25, 2018 Ex Parte Technical Study.

[6] See Ubiquiti Networks Comments on NPRM, ET Docket No. 18-295 (filed Dec. 21, 2018).

Dedicated Short-Range Communications (DSRC, 5.9GHz)

While not directly addressed in this NPRM, we briefly comment on the 75 MHz currently assigned to intelligent transportation services between 5.850-5.925 GHz. We agree with many commenters in other proceedings related to this band, which is adjacent to the 6 GHz band and ripe for reform. However, the availability and cost of various technologies are just now becoming attractive enough to allow wide-scale adoption of vehicle-to-vehicle communication. In the context of education, we specifically are concerned about traffic safety for school buses.

According to the NCDPI, vehicles illegally passing school buses that are stopped, with flashing red lights, and children embarking or disembarking the bus is a serious safety concern for the state.[7] Any technology that could be deployed over the next decade to address this issue, and many other traffic and vehicle safety related issues, should be pursued by the FCC, DOT, and other applicable government agencies. Self-driving and intelligent vehicles are still in their infancy; the FCC was likely two decades ahead of the technology available when the original allocation was created in 1999. We encourage the Commission to pause and let the technology develop before reallocating this spectrum to another use, including unlicensed.

Summary

We support the Commission's efforts to modernize the 6 GHz band and spur innovation through its use in unlicensed products with reasonable, cost effective, easy-to-understand dynamic spectrum management. Educational networks are some of the most challenging, and the availability of an additional gigahertz of spectrum for use in classrooms could lower operational costs and increase network access, throughput and reliability for students. We thank the Commission and the FCC for their consideration of our thoughts.

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[7] North Carolina Department of Public Instruction, http://www.ncbussafety.org/stoparmviolationcamera/